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Atmospheric Measurement Techniques Discussions

Interactive comment on "A dual, single detector relaxed eddy accumulation system for long-term measurement of mercury flux" *by* S. Osterwalder et al.

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General comment:

Osterwalder et al. report on a new design of a GEM REA system, its design, implementation and preliminary data from two contrasting study sites. I think this is an excellent paper - the new REA design will certainly help to make more defensible GEM flux measurements over extended periods in the future, which is urgently required to better constrain the global mercury cycle. The paper is well suited for AMT(D), is well written and adequately presented.

Response: Thank you very much for these encouraging comments and suggestions. We appreciate that you highlight the importance of accurate, automated and long-term GEM flux measurements to better constrain the global mercury flux at landscape scale. We are also grateful for the specific comments to improve clarity and readability of the manuscript.

Specific comments:

1) p. 8117, l. 13-16: this technique has been termed eddy accumulation, as opposed to REA

Response: We have added the term to the manuscript and changed the sentence as follows:

Suggested changes in the manuscript: "To overcome the need for fast-response sensors, Desjardins (1977) has introduced the eddy accumulation method where fast-response sampling valves . . ."

2) p. 8117, l. 23: say something about the drawbacks of REA as well? E.g. no postprocessing coordinate rotation?

Response: We concur with the reviewer that it is important to make the drawbacks that come along with the REA method clear in the paper. As suggested we complement the paragraph with two additional sentences about REA disadvantages.

Suggested changes in the manuscript: "As a disadvantage the technical requirements for REA are very stringent, especially under windy conditions, increasing the demand on the precision of the sampling and chemical analysis. Irregularities in offset measurements and timing of the sampling valves can also not be corrected later (Sutton et al., 2001)."

3) p. 8118, l. 18: the concept of the "dual inlet REA" as opposed to single inlet systems should be introduced here

Response: We wrote this out in the manuscript (see below).

4) p. 8118, l. 18-p. 8119, l. 11: reformulate this section to explicitly include a statement of objectives for this study

Response: We have revised the section accordingly.

Suggested changes in the manuscript: “To address these needs we designed a fully automated REA system with two inlet lines for separate but continuous sampling of updraft and downdrafts. These are collected on gold traps before analysis on a single Hg detector. From this continuous GEM fluxes are measured over a homogeneous terrestrial landscape. Our main objective was to improve earlier REA systems with the following features:

I) continuous, simultaneous sampling of Hg in up-and downdrafts by using two pairs of gold cartridges.

II) regular analysis of a GEM standard as well as dry, Hg-free air to monitor instrument sensitivity.

III) reduce staff effort during flux monitoring due to fully automated GEM sampling system and GEM analysis

To test the system’s performance under field conditions, we deployed it in two contrasting environments during campaigns of two to three weeks each."

5) p. 8120, l. 1-2: the name of the urban study site has not been mentioned previously

Response: Thanks for the remark. The urban site is now introduced in the Introduction on p. 8118.

6) p. 8121, l. 2: ‘: : : was recorded : : :’

Response: We followed the suggestion.

Suggested changes in the manuscript: “A suite of meteorological parameters were

recorded as well: . . . “

7) p. 8121, l. 6: refer to Table S1 after (A1, A2)

Response: We refer to Fig. 1 since it is indicated above that all the components are listed in Table S1.

8) p. 8121, l. 10: ‘: : : were installed : : :’ – use past tense throughout!

Response: We changed that and screened the manuscript again for past tense.

9) p. 8123, l. 15: ‘: : : were performed : : :’

Response: Done

10) p. 8124, Eq. 5: as the equation stands the ratio amounts to unity

Response: The parameters in equation 5 are explained clearly now.

Suggested changes in the manuscript: “The analyzed air samples (Aa) for each cartridge were corrected for temperature sensitivity of the Hg detector by dividing the averaged GEM reference air samples over the entire campaign through single GEM reference air samples (Ab_r) according to: . . .”

11) p. 8125, l. 5: ‘: : : will be determined : : :’, as this is yet to come at this point?

Response: We changed that in the manuscript.

12) p. 8125, l. 12: the integral turbulence test would also identify larger than expected turbulence – basically this test looks at the deviation from the modeled value

Response: Many thanks for this remark. We agree entirely, the integral turbulence test compares the measured values with modeled values for both higher and lower turbulence than the expected values calculated with equation 8. For our quality filtering we used a factor 2 threshold. That means that data were rejected for periods when the deviation of the measured integral turbulence characteristic was a factor two higher or lower than the modeled value. We stated that more clearly in the text.

Suggested changes in the manuscript: “A deviation by > a factor of 2 from the model was used as the threshold to reject periods of insufficient turbulence as well as periods of larger than expected turbulence (Fig. 2S in the Supplement): . . . “

13) p. 8125, l. 14: you mean the sonic measurement of the three wind components?

Response: We stated that more clearly:

Suggested changes in the manuscript: "The effect of a potentially dampened GEM flux due to high- and low-frequency losses of the turbulent eddies has been derived by interpretation of turbulence spectra for both sites dependent on instrumental properties (lateral sensor separation), measuring height, wind speed and stability conditions (Sect. 3.3)."

14) p. 8130, l. 8: ‘: : : showed : : :’

Response: Done

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 8113, 2015.